AD-A067 739 NAVAL RESEARCH LAB WASHINGTON D C F/G 17/8

USE OF THE FOLDED-PATH TRANSMISSOMETER DURING CEWCOM-78.(U)

APR 79 H E GERBER, R K STILLING

UNCLASSIFIED NRL-MR-3958 NL

1 OF 1

ADA

067739

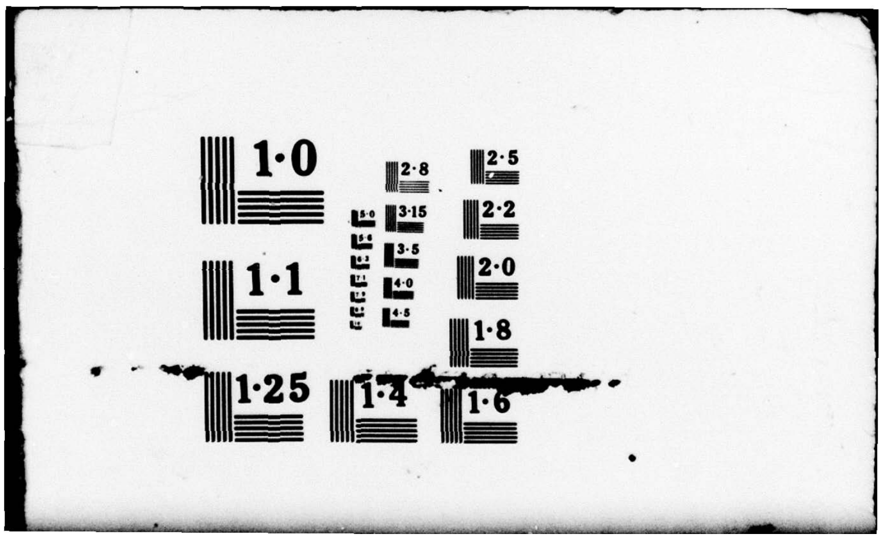
END

DATE

FILMED

6-79

DDC


1·0
2·8
2·5
3·15
2·2
3·5
2·0
4·0
1·1
4·5
1·8
1·25
1·4
1·6

NRL Memorandum Report 3958

Use of the Folded-Path Transmissometer During CEWCOM-78

H. E. GERBER AND R. K. STILLING

Atmospheric Physics Branch
Ocean Sciences Division

April 10, 1979

NAVAL RESEARCH LABORATORY
Washington, D.C.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NRL Memorandum Report 3958	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) USE OF THE FOLDED—PATH TRANSMISSOMETER DURING CEWCOM—78		5. TYPE OF REPORT & PERIOD COVERED An interim report on a continuing NRL problem.
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) H. E. Gerber and R. K. Stilling		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Research Laboratory Washington, D.C. 20375		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NRL Problem A03-14B
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Navy Naval Air Systems Command Washington, D.C. 20361		12. REPORT DATE April 10, 1979
		13. NUMBER OF PAGES 9
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Department of the Navy Naval Ocean Systems Center San Diego, California 92152		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

(6) (10) (11) 10 Apr 79 (12) 10p.

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

(14) NRL-MR-3958

18. SUPPLEMENTARY NOTES

(9) Interim rept.,

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Transmissometer
Transmission measurements
Aerosol extinction coefficient
Surf-zone aerosol

micrometer.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The folded-path transmissometer was taken to San Nicolas Island to compare its operation with the operation of the Barnes transmissometer during CEWCOM-78. The comparison was to include transmission measurements in the red portion of the visible spectrum and at 10.6 μm in the infrared. Modifications of the folded-path transmissometer to include the infrared are described. Red-light transmittances measured with the folded-path system were 20% larger on the average than those measured with the Barnes system. Failure of the 10.6 μm source of the folded-path system

(Continues)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

79 04 20 027

251 950

20. Abstract (Continued)

prevented comparisons at that wavelength. The influence of surf-zone-produced aerosol particles on the validity of the measurements is discussed.

List of Contents

INTRODUCTION

The folded-path transmissometer consists of a 2-m cell in which the extinction of light by aerosol particles is measured. The light beam is folded to attain a total path length of 20-m, and the cell is filled with concentrated ambient aerosol particles to increase the effective path length to several hundred meters. A detailed description of the system is given elsewhere[1].

The purpose of our participation in the 1978 Cooperative Experiment for West Coast Oceanography and Meteorology (CEWCOM-78) was to compare the operation of our transmissometer located at site A on San Nicolas Island with the Barnes transmissometers located between site A and site B and operated by PMTC. The comparison was to include two different portions of the light spectrum. Laser wavelengths of 632.8 nm and 10600 nm used with the folded-path transmissometer were to be compared with the wavelength interval of 500-700 nm and a narrow wavelength band near 10600 nm used with the Barnes system.

This report describes the modifications which were made to the folded-path transmissometer to make possible simultaneous measurements at two light wavelengths. A 10600 nm light source (CO_2 laser) was added to the 632.8 nm source (HeNe laser) which was used in all previous measurements. Results of the comparison are given and the validity of the measurements is discussed.

INSTRUMENTATION

The transmissometer was modified as shown in Fig. 1 to accommodate the CO_2 laser and associated optics. The CO_2 laser (model 941P from GTE Sylvania; 3-W, Tem_{oo} mode, linearly polarized) is mounted on the side of the 20-m long cell. A model 485 attenuator is used with the laser. The CO_2 beam is focused and aimed with an adjustable mirror and is split into two portions with a germanium flat anti-reflection coated on one side. One portion of the beam steps through the cell for a total beam length of 20-m in the concentrated aerosol and the other portion is used as the reference. The HeNe system functions in a similar manner, except for the addition of the circular polarizer which is necessary, since the flux of light scattered by the aerosol particles

Note: Manuscript submitted January 10, 1979.

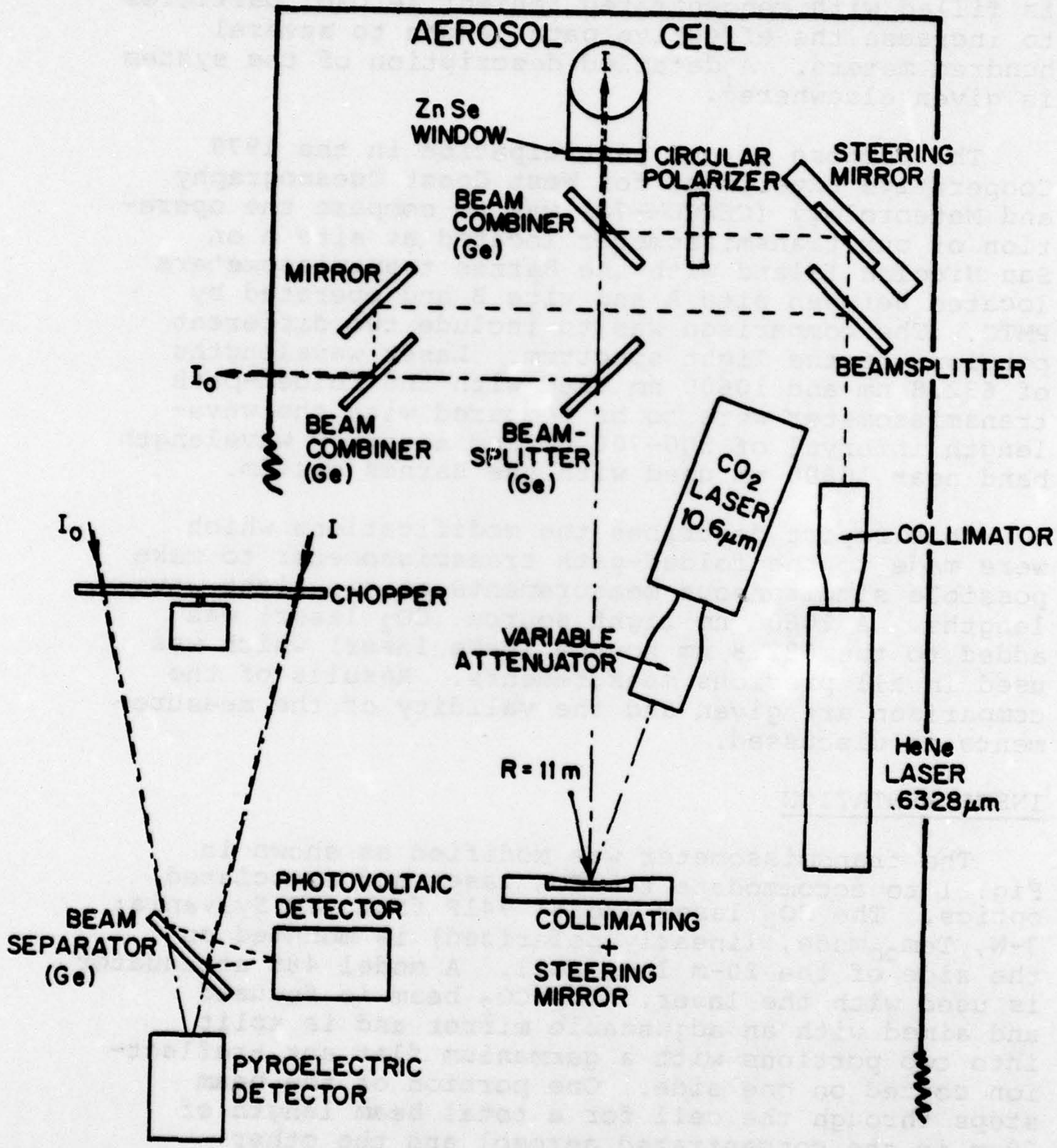


Fig. 1 - Schematic of the two-wavelength optical system

and measured by the cosine sensor on the cell wall must be essentially randomly polarized. The two beams enter coaxially into the cell through a zinc selenide window which has good transmittance characteristics in the visible and the infrared portions of the spectrum. The reference beams and the beams transmitted through the cell are all routed with front surface mirror flats (not shown) through a chopper (20Hz) and to a germanium flat where the HeNe beam is reflected and the CO_2 beam is transmitted. The holes on the chopper are so arranged as to alternately illuminate the germanium flat and the sensors just beyond it. This arrangement permits simple electronic circuitry to determine the relative extinction of the beams by the aerosol in the cell by measuring the intensity of the light transmitted through the cell and by dividing it by the reference beam intensity. In this manner laser output drift and detector sensitivity changes become unimportant for noise with a frequency less than the chopping rate. The infrared sensor is a pyroelectric detector, model kT-4080 from Laser Precision Corp. The detector current sensitivity is 1.7 μ-Amp/Watt, transfer characteristics (preamp output) is 10^8 Volts/Amp, and NEP is 6×10^{-10} Watt.

To prepare for operation of the transmissometer, the HeNe beam is aligned to properly pass through the cell. Since the two beams are coaxial at the point where they enter the cell, it is reasonably simple to also align the CO_2 beam. During operation, the reference beams, which were adjusted to be slightly stronger than the transmitted beams, are reduced under clean cell conditions to give a null signal output. The accuracy of the extinction measurement for the CO_2 beam, as determined in the laboratory, is several times the 0.1% accuracy of the HeNe measurement. The manufacturers' quoted short-term stability of the CO_2 laser and the NEP of the sensor should have resulted in a much better accuracy.

The cell was located ≈25 m from site A on San Nicolas Island. It was inside a small wooden building which was well ventilated to avoid cell-ambient temperature differences. A vent at the upwind side of the building sampled the ambient aerosol.

RESULTS AND DISCUSSION

No data was collected with the CO_2 system on the portable transmissometer. The CO_2 laser failed to operate properly and could not be repaired.

Some transmittance measurements were obtained with the HeNe system. Measurements with the portable transmissometer and the Barnes transmissometer operating with the 500-700 nm filter are compared in Fig. 2. The points represent measurements taken at least within one-half hour of each other.

Figure 2 shows that the portable transmissometer gave values about 20% larger on the average than those given with the Barnes system. That agreement is surprisingly good in view of the facts that the bandwidth of the wavelength response differed for each instrument, that one instrument gave a point measurement and the other integrated over several Km, and that the portable system was under the influence of aerosol generated by waves breaking on the shoreline several hundred meters upwind. On occasions of strong surf and/or high wind, the surf-zone aerosol dominated over the natural aerosol background. However, on the other and more numerous occasions, the surf-zone aerosol only influenced the measurements by a small amount as shown by Fig. 2. Since the particles from the surf-zone will tend to be large, especially under high humidity conditions, light with longer wavelengths may well be influenced to a greater degree. It is clear that some uncertainty will be introduced into the characterization of the marine aerosol by measurements influenced by the surf-zone. To avoid this uncertainty all point measurements with transmissometers, nephelometers, particle-size spectrometers, etc. taken at ground level just inland along the western shore of San Nicolas Island should instead be taken above the aerosol layer originating near the surf-zone. Near site A this layer appeared to be between 50 and 100 feet thick.

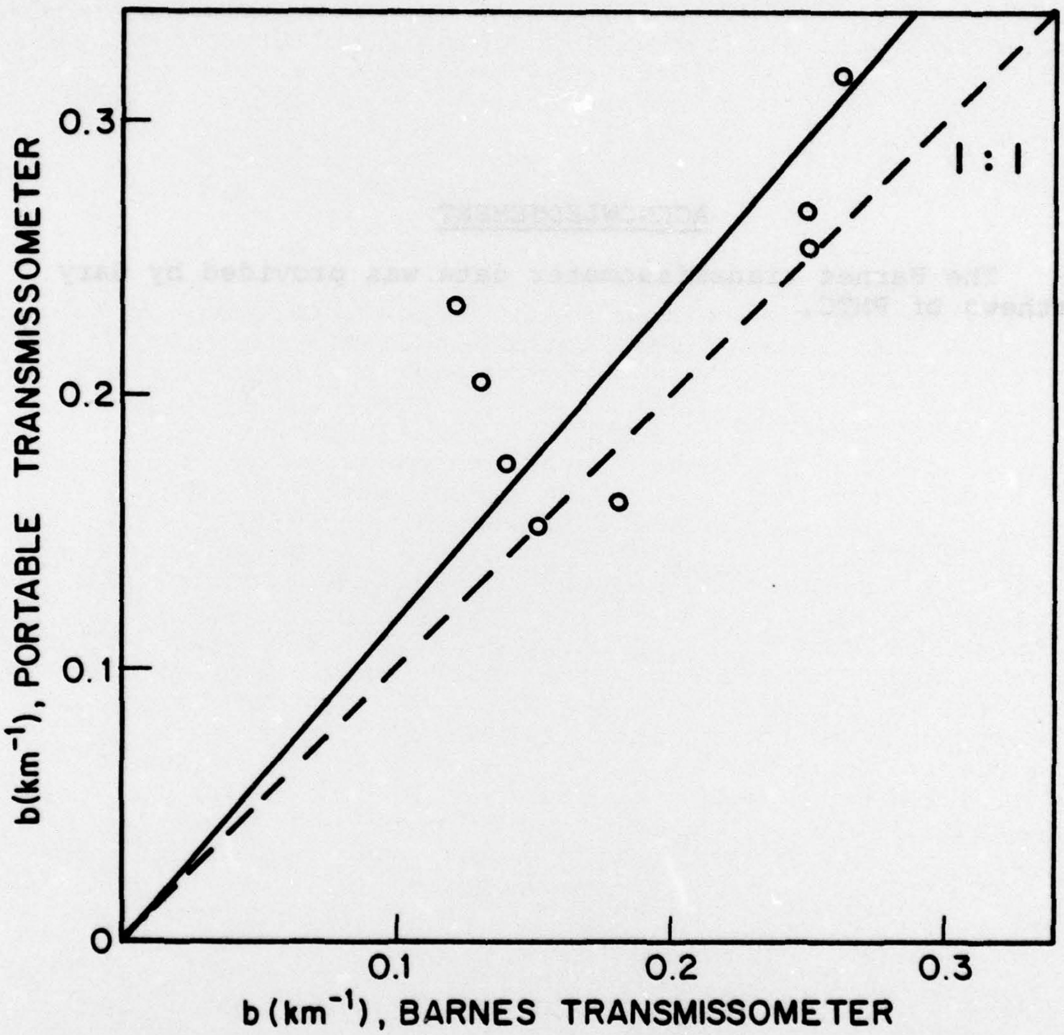


Fig. 2 - Comparison of extinction coefficients (b) measured during CEWCOM-78 with the Barnes transmissometer operating in the wavelength band of 500-700 nm and the folded-path transmissometer operating at 632.8 nm

REFERENCE

Gerber, H. E., 1978: "Feasibility of Shipboard Laser-Attenuation Measurements with a Portable Transmissometer". NRL Report 8290.

ACKNOWLEDGEMENT

The Barnes transmissometer data was provided by Gary Mathews of PMTC.